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(54) A PROCESS FOR THE PREPARATION OF AN IMPREGNATED AND SURFACE-FINISHED FOIL

(71) We, BILLINGSFORS BRUKS AB, a Swedish Body Corporate of Billingsfors, Sweden, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

The present invention relates to a process for the preparation of an impregnated, surface-finished foil intended for attachment to supports, for instance to particle boards.

In the furniture industry there is a strong need for pre-fabricated surfaces, i.e. surfaces not in need of painting. Said need has hitherto largely been fulfilled by using melamine impregnated printed and unprinted papers, which are for example pressed onto particle board or a furniture part under increased temperature and pressure. From several aspects these surfaces have suitable characteristics, but cannot from an aesthetical point of view be compared to a surface painted in the usual manner.

Attempts have been made to combine such melamine impregnation with a subsequent coating using paint components for the purpose of imparting to the surface a painted appearance and the corresponding characteristics. However, this procedure has not given satisfactory results, since, simply expressed, a paper to be impregnated must have large pores to facilitate the impregnation and, in contrast thereto, the subsequent coating calls for a dense paper to give good results.

By carrying out the impregnation in a paper making machine before the final drying it is possible to manufacture a dense paper with a sufficient resin content which is well suited for subsequent coating. The addition of the resin may be carried out in different ways depending on the requirements of the final product and on the technical equipment, and the resin solids content may also be varied in a corresponding degree within such broad limits as from 5 to 60 per cent by weight based on the weight of paper and resin.

The reason why this process is advantageous seems to be the fact that the cellulose fibers in a manner known *per se* undergo irreversible changes during the drying in the paper making machine. In order to achieve subsequent impregnation it is normally necessary in the manufacture of the paper to make the paper very open, i.e. the fibers must not be beaten too much, so that the paper has a pore system which facilitates the impregnation. However, this porosity remains, after the impregnation and provides difficulties for the subsequent coating. It is desirable to maintain a subsequently applied coating paste on the surface, but the openness or porosity of the paper causes it to penetrate instead.

If impregnation with an impregnating agent based on a thermosetting resin, for instance of the urea or melamine resin type, is carried out in conjunction with the paper making before the final drying, either by supply to the stock or in the paper making machine by spraying, in a size press or bath or a combination thereof, the above difficulty can be avoided. Thus, as long as the paper has not been finally dried, it maintains its porous structure and is easily impregnated also at higher degrees of beating and thus gives, after final drying, a denser paper. In this case the paper may also be provided with a machine-glazed surface further improving the result of the subsequent coating.

However, the above-disclosed impregnation in a paper making machine suffers from some disadvantages in connection with the subsequent surface- finishing treatment. Thus, it may be difficult to obtain, by coating with a pigment paint, a surface layer which covers the surface completely even if the coating is repeated several times. In addition,

a so-called glue or adhesive strike-through may result when the foil is pressed onto a support, for instance a particle board, under increased temperature and pressure. According to the present invention, a process is provided which eliminates or at least reduces the above-mentioned disadvantages.

The present invention provides a process for the preparation of an impregnated, surface-finished cellulosic foil suitable for attachment to a support, which comprises making a cellulosic-based foil in a paper making machine, and, prior to final drying, incorporating in the foil an impregnating and surface-finishing agent in the form of a solution or dispersion of a plastics material, at least a part of which agent is a dispersion of a thermosetting resin, in a quantity which imparts to the foil a Gurley porosity of at least 40 sec /100 ml.

A particularly suitable impregnating agent to be used in the present invention is in the form of an aqueous dispersion of an acrylic resin, and preferably includes a minor amount of a dispersion of a thermoplastic resin.

The foil prepared by this process has a markedly increased hardness and thereby improved grindability and improved surface structure, the subsequent surface-finishing or coating being considerably facilitated. The modulus of shear of the plastics material at the final drying temperature, which generally exceeds 100 °C, should preferably be from 10^7 to 10^9 dyn /cm ^{2}. By using such material, at the final drying some softening of the plastics material in the form of beads or particles results, and a levelling of these and clogging of the pores of the foil takes place. The process of the invention must result in a Gurley porosity of the foil of at least 40, especially at least 60, sec /100 ml.

The foil, e.g. paper, obtained can be applied directly onto a support, for instance a particle board, or can be surface-finished further by coating in one or more stages. Before the final coating, if such a coating is desirable or necessary, it may be suitable to perform a slight grinding of the surface of the foil, which is preferably not performed until the foil has been applied onto a carrier or support.

Unexpectedly, the size of the particles in the impregnating agent does not seem to be especially critical in relation to the porosity of the foil used. However, the softening curve is a direct function of the above-mentioned modulus of shear. A preferred range fo the particle size is from 0.1 to 10 microns, and suitably the dispersion contains particles from the upper part of said range to some extent.

What is surprising in connection with the present invention is the fact that the impregnation of the foil, for instance with impregnating agents containing plastics material of the urea or melamine resin type, does not seem to be disturbed or influenced by the presence of a resin dispersion of the above-identified type. One would expect the impregnating capacity to be markedly impaired by the presence of the dispersion but this does not seem to be the case.

By treating the foil in accordance with the process of the present invention before the final drying step with a resin dispersion of the above-metntioned type, essential advantages are obtained, for instance for the subsequent coating. Thus, in many cases it is possible to obtain a satisfactory surface structure by one single coating only. In addition, the appearance of so-called adhesive strike-through at the subsequent pressing is avoided to a great extent, probably due to the fact that the two faces of the foil are favourably influenced by the presence of the resin dispersion. Furthermore, a surface is obtained which is well suited for printing patterns of various kinds.

The subsequent surface-coating may be carried out in a manner known *per se*. If an aqueous dispersion is used, air brush or blade coating techniques are preferred, whereas, if the composition contains solvents or other volatile components, roller coating or coating in a so-called curain coating machine have been found to give the best results.

In principle, any type of thermo-plastic or thermosetting resin which is compatible with or dispersible in water may be used as the plastic material. Particularly suitable resins are the aminoplasts, for instance urea or melamine resins. However, it is possible to use, for example, thermosetting resins of the phenolic-, acrylic, epoxy, polyurethane or polyester resin types.

The plastics material used for surface-finishing the foil may be any type of thermosetting resin, and may, for example, comprise a combination of a thermosetting resin plus a thermoplastic resin which show a suitable modulus of shear at the final drying temperature. Useful dispersions are those based on one or more thermosetting resins of the phenolic, acrylic, epoxy, plyurethane, and polyester types. The dispersions sold by Rohm GmbH, Darmstadt, West Germany, under the Registered Trade Mark "PLEXTOL" and based on cross-linkable acrylic resins are especially useful. "PLEXTOL" BV 410 and "PLEXTOL" BV 595 are of special interest in this context because of their modulus of shear at the appropriate final drying temperatures. Within the temperature range of 100 to 150 °C the modulus of shear of these two dispersions is about 2×10^8 dyn /cm ^{2}, which is found to be a suitable value for imparting a favourable surface structure to the foil.

The amount of impregnating agent used may vary within relatively broad limits; a

suitable range is from 5 to 60, e.g. 5 to 40, per cent by weight solids, by weight of the total solids content of the foil and resin in the foil before the final drying and the subsequent surface-finishing. A specially preferred range is from 10 to 30 per cent by weight. If desired, at least half and especially at least 2 /3 of the plastics material, by weight solids in the plastics material, is the thermosetting resin, the balance being a thermoplastic resin. The solids content of the impregnating surface-finishing agent is preferably at most 50 per cent.

Pigments, optionally together with binders, used for the final coating may have a broadly varying composition in conformity with conventional techniques. Titanium dioxide, clay or chalk may, for example, be used as pigments. Examples of binders which may be sued are, for example, in the form of a dispersion of an acrylic latex, styrene butadiene latex, melamine resin or urea resin, or are the UV-curing or catalyst-curing polyesters or are of the nitro-cellulosic or4 acid-curing type. The coating composition may also contain a colouring agent if this is desirable. In some cases satisfactory results may be obtained by coating with a lacquer only, i.e. free from pigment.

The invention will be further illustrated by the following Examples. In these Examples the porosity is the Gurley porosity which is determined according to the standard method SCAN-P 19:66.

Example 1

A paper (about 60 g /m ^{2}) of bleached sulphate cellulose was prepared under simultaneous addition ofa bout 10 per cent by weight of a urea resin (solids content based on the dry weight of the paper) in the stock. Then about 15 per cent by weight of a urea resin and about 5 per cent by weight of an acrylic resin dispersion (solids content based on the dry weight of the paper) were added by spraying onto the paper web after the press section. The urea resin added to the stock was a resin having the Registered Trade Mark "Dynorit" L 320 (Dyno Industrier, Norway), and that applied to the paper web by spraying was "Kaurit" 210 (BASF, West Germany – "Kaurit" is a Registered Trade Mark) together with 0.02 per cent by weight of NH_4Cl as a curing agent. The acrylioc resin dispersion was "PLEXTOL" BV 410 (Rohm GmbH, Darmstadt). After the final drying the paper had a surface weight of about 80 g /m ^{2} and a Gurley porosity of 60 sec /100 ml. The foil obtained was used for covering furniture parts by applying urea resin glue to a particle board, then applying the foil and attaching same by pressing in a press at a pressure of 6 kp /cm ^{2} for 15 seconds at about 140 °C. In a subsequent process the foil was coated after a slight grinding, with 140 g /m ^{2} of a pigmented polyester lacquer having added thereto a peroxide catalyst.

The product obtained had a hard, smooth surface suitable for the exterior of shelves and cabinets and showed no adhesive or glue strike-through.

Example 2

A paper (about 100 g /m ^{2}) of bleached sulphite cellulose was impregnated in the middle of the drying section of a paper making machine in an inserted batyh with 32 g /m ^{2} of a melamine resin and 8 g /m ^{2} of an acrylic resin dispersion and a machine-glazed surface was imparted thereto. The melamine resin used was Kauramin 772 (BASF, West Germany) together with 0.025 per cent by weight of HCOOH as a curing agent and the acrylic resin dispersion was "PLEXTOL" BV 595 (Rohm GmbH, Darmstadt). After final drying the paper had a surface weight of 140 g /m ^{2}. The Gurley porosity was 80p sec /100 ml. Then the paper was coated in two steps with a titanium dioxide pigmented melamine solution. The total amount applied was 25 g /m ^{2}. Under the same conditions as in Example 1 the foil was pressed with wet glue on a particle board without showing any glue strike-through. It was then used for the dinsides of kitchen fittings.

Example 3

A paper (about 120 g /m ^{2}) of bleached sulphate cellulose with 15 per cent by weight of pigment was impregnated with 34 g /m ^{2} of a urea resin and 24 g /m ^{2} of an acrylic resin dispersion in the middle of the drying section of a paper making machine in an inserted size press. The urea resin used was "Kaurit" 210 (BASF,, West Germany) without any curing agent, and the dispersion contained 16 /m ^{2} of the same acylic resin dispersion as in Example 2 together with 8 g /m ^{2} of a thermoplastic acrylic resin dispersion, namely "PLEXTOL" D 469 (Rohm GmbH, Darmstadt). A dried sample, taken downstream of the size press, showed a Gurely porosity of 120 sec /100 ml. After further drying the paper was coated in a blade coating device inserted into the paper making machine with 20 g /m ^{2} of a water-dispersed acrylate latex, a so-called lacquer4. The final foil was used after final drying in similar manner as in Example 1 for covering the interior of simple cabinets and wardrobes.

WHAT WE CLAIM IS:–

1. A process for the preparation of an impregnated, surface-finished cellulosic foil suitable for attachment to a support, which comprises making a cellulosic-based foil in a paper making machine and, prior to final drying, incorporating in the foil an impregnating and surface-finishing agent in the form of a solution or dispersion of a plastics material, at least a part of which agent is a

dispersion of a thermosetting resin, in a quantity which imparts to the foil a Gurley porosity of at least 40 sec /100 ml.

2. A process according to claim 1, wherein the plastics material is 5 to 60 % by weight of the total solids prior to final drying of the foil.

3. A process according to claim 2, wherein the weight of plastics material is 5 to 40 %.

4. A process according to any one of the preceding claims, wherein at least half the plastics material, by weight solids in the plastics material, is a thermosetting resin, the balance being a thermoplastic resin.

5. A process according to claim 4, wherein at least 2 /3 the plastics material, by weight solids in the plastics material, is a thermosetting resin.

6. A process according to any one of the preceding claims, wherein the plastics material has a modulus of shear at the final drying temperature of 10^{7} to 10^{9} dyn /cm ^{2}.

7. A process according to any one of the preceding claims, wherein the plastics material comprises an acylic resin.

8. A process according to any one of claims 1 to 6, wherein the thermosetting resin is an aminoplast.

9. A process according to claim 8, wherein the aminoplast is a urea or melamine resin.

10. A process according to any one of claims 1 to 6, wherein the thermosetting resin is a phenolic, acrylic, epoxy, polyurethane or polyester resin or a mixture of two or more of these resins.

11. A process according to any one of the preceding claims, wherein, after drying, the foil is coated with a lacquer.

12. A process according to any one of claims 1 to 10 wherein after drying, the foil is coated with a pigment which is titanium dioxide, clay or chalk.

13. A process according to claim 12, wherein the foil is also coated with a binder in the form of a dispersion of acrylic latex, styrene-butadiene latex, melamine resin or urea resin.

14. A process according to any one of claims 1 to 10, wherein after drying, the foil is coated with a mixture of pigment and a binder which is a UV-curing or catalyst-suring polyester or a binder of the nitrocellulose type or acid-curing type.

15. A process according to claim 1, substantially as hereinbefore described with reference to any one of the Examples.

16. A foil obtained by a process according to any one of the preceding claims.

17. A laminate comprising a support and a foil according to claim 16.

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